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Geo-Spatial Analysis of the Water logging Area in Hisar District

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Abstract:

Waterlogging and salinity are two problems that are prevalent in irrigated areas of developing countries such as India. Waterlogging causes agricultural patterns to shift, resulting in inefficient land usage. Geospatial approaches were found to be useful in representing the geographical distribution of surface waterlogging throughout the Hisar district as well as selected sites in Hisar all Blocks, as well as field validation. Upward flowing water also delivers salt to the land surface, resulting in the salinization process. The problem of soluble salt deposition in the soil profile is associated with the state's incidence of waterlogging. Because of the concentration of salts in the upper layer, the soil becomes saline; ground water going upward carries salt contents that, after evaporation, collect at the surface.In dry and semi-arid locations, waterlogging is usually followed by salinization. As a result, it is classified as a dual problem. Prolonged surface water stagnation or root zone saturation caused by inadequate drainage and a shallow water table restricts air diffusion in the soil and lowers the oxyzen level. This is referred to as waterlogging. Waterlogging causes cropping patterns to shift, resulting in inefficient land use.

Keywords: Waterlogging, Geospatial Techniques, Classification, Estimation.

Introduction:

Koshal (2012) identified saline areas using IRS 1D LISS III satellite images from March and May 2000. In this regard, a reconnaissance survey of the research region was conducted. The areas of Muktsar and Bhatinda were discovered to be in a critical state due to waterlogging, salinity, and secondary salinity. In the March IRS 1D image, crops appear to wither away in salt-affected lands, resulting in a significant loss of yield. In the future, multi-temporal satellite images should be used for continuous monitoring of the region's waterlogging and salinity dynamics.

Satellite data can be used to get information on drainage basin area and drainage pattern.imagery. According to Barret and Curtis (1976), stream channel development and network, stream Landsat-MSS data can be used to map the length and position of ponds and lakes. GIS aids in evaluating the waterlogging and drainage issue by defining the drainage network and its components A basin's characteristics, in addition to information on the presence of a high water table and high morphology, Soil colour, plant stress, and water collection in low-lying areas The charting of drainage networks Some have used the Digita1 Elevation Model (DEM) as part of their GIS study, researchers.

According to Datta et al. (2000), an acceptable technique for increasing agricultural output is a combination of surface and subsurface drainage enhanced by improved irrigation management. The study was carried out to investigate the cost of installing subsurface drainage, the direct on-farm advantages of subsurface drainage, and the financial feasibility of subsurface drainage in the state of Haryana. The results show that after the installation of drainage, cropping patterns changed to more profitable crops, crop yields increased, farmers were gainfully employed, and farm revenue increased. As a result, drainage in wet and saline areas was discovered to be financially and economically feasible.

Bangladesh is a country prone to excessive rains and flooding. The average annual rainfall is approximately 2320mm. As the world's most densely populated country, cities here confront recurring issues such as traffic congestion, water logging, water pollution, inappropriate trash management, and so on. Water logging is one of the most serious issues in metropolitan settings. With uncontrollable population expansion and unplanned urbanisation, drainage and sewer facilities are not growing in a timely manner. This study will conduct a case study of present urban water logging in Bangladesh, attempting to emphasise the key causes, the impact of implemented projects, and people's perspectives on the implications of water logging in their urban regions.

According to Joshi (1987), in the early stages, production in the afflicted areas falls precipitously. If there is no Regardless of corrective attempts, the land eventually becomes Wasteland and is no longer cultivable. The outcome has an impact on one loss of natural resources, ecological imbalances, unemployment, regional disparities, and an increase in poverty and out-migration migration. Excessive wetness in the soil encourages plant development in waterlogged places. Additional groundwater Capillary action causes water to rise and evaporate off the land surface, resulting in an accumulation of water. salts found in the soil profile Salinisation is the process by which salt accumulates.

What is Waterlogging?

Waterlogging is simply the temporary or permanent soaking of soil with water. When there is an excess of water in a region, the soil is unable to absorb it as it should.It can also occur when the water table rises to the point that the soil pores in the crop root zone get clogged.

As a result, the natural supply of air in the soil is restricted, oxygen levels fall, and levels of carbon dioxide and ethylene rise.

Study Area:

Haryana's Hisar district was the subject of the study. It is situated in the west central region of Haryana, between latitudes 28o 56'00"N and 29o 38'30" N and longitudes 75o 21'12"E and 76o 18'12" E. (Fig. 3.1). It borders Fatehabad district to the north and north-west, Jind district to the north and north-east, Bhiwani district of Haryana to the south, and Rajasthan to the east and west. Hisar district has a total size of 4062 km2. Agroha, Adampur, Barwala, Bass (Hansi-II), Hansi-I, Hisar-I, Hisar-II, Narnaund, and Uklana are the nine blocks that comprise the Hisar district. The average annual rainfall is roughly 450 mm, with the South-West Monsoon season accounting for 75 to 80 percent of the total (June to September).

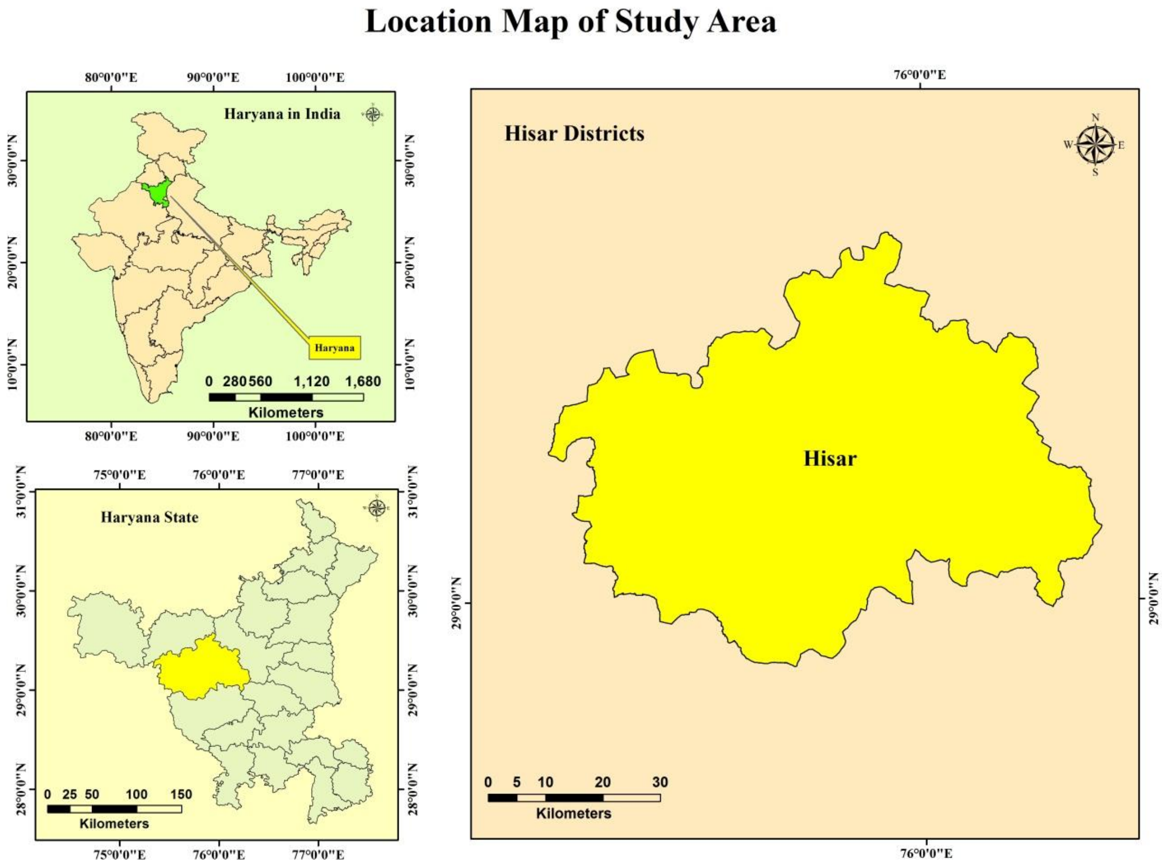

Figure:1

Methodology:

Site investigation (collection of GT Points)

The salt-affected area was observed on the ground surface. The site's location map, complete with observation points taken uniformly throughout the field. Due to the changes in Waterlogged Area and topographical characteristics in the study area, land truth was gathered, along with ground pictures and GPS locations. During the ground reality, the suspicious regions on the pre-field interpreted maps were checked, and the pre-field maps were modified by adding field observations.

Satellite Data used:

Sentinel satellite data from September 28th, 2021, with a resolution of 10 m, was used to identify surface wet areas. The collected photos were layer stacked and mosaicked before being trimmed to the district boundary to produce the final False Colour Composite (FCC) (Blue, Green, and Near Infrared) image. The photograph was visually analysed to detect surface waterlogged areas in Hisar district based on shape, size, texture, tone, and association. The surface waterlogged region was identified as a dark blue to blackish red mixed tone with uneven shape and roughness with mottled texture and digitised manually on a normal FCC image. Water bodies were thought to be dark black tones within regular shapes and were not represented as surface waterlogged areas.

The Sentinel-2 photos of the site on the 5th of November 2021 and the 4th of May 2022 were chosen using a temporal slider to shift between acquisition dates imagery to ensure the presence of surface waterlogged area at the specified site. The selected photos were geo-referenced using control points from the geo-referenced image Sentinel-2 of the Hisar district in ERDAS envision 2011 and cropped to the site boundary. The surface waterlogged area was manually digitised on a normal True Colour Composite (TCC) image by taking into account bright green to black tone, surface ponding, and irregular shape as surface waterlogged area.

GIS and Remote Sensing Technique:

The irrigation command's saline and waterlogged zones are delineated using the widely accepted supervised classification method was utilized. The five classes listed below are cropped The following areas were identified: ponded water area, waterlogged area, salty area, and salt-affected agricultural area on the satellite picture The classification was performed on the Sentinel-2 image to demonstrate the dynamics. November 2021 Multi Spectral image, the 4th of May 2022 Multi Spectral image, The produced In order to fix the incorrectly classified pixels, the raster map was filtered using the majority filter. The sample data show that care was taken to select a suitably homogeneous area for each class. When the sample set for all classes was complete, the supervised classification was tried, and the classified map was obtained. The statistics on the area distribution of the various classes were examined. It appears that a complete set of ground truth was not accessible for all of the dates. The training-sets were created mostly based on knowledge of cropping patterns and location in the study area.

Result and Discussion:

Following an investigation, it was discovered that the Hisar district suffers from both surface and underground waterlogging. The surface waterlogged area was found to be the greatest in the central and south-eastern parts, accounting for about 7.76 percent of the total area, indicating a serious waterlogging problem during the Kharif season, as shown in Fig. 2. Visual interpretation was used to identify the surface wet area in the FCC photograph. The visual study found that the water bodies, canals, and roadways have a definite shape (regular) and size that distinguishes them from the irregular pattern of surface waterlogging. The surface waterlogged area was easily identifiable during visual image inspection as dark blue to blackish red mixed tone (increased absorption of electromagnetic radiation in visible and near infrared band), uneven in shape and coarse with mottled texture.

In Hisar district, the total surface waterlogged area was 315.30 km^2, accounting for roughly 7.76 percent of the entire area. The centre and south-eastern areas of Hisar district were determined to have the most surface waterlogging.

The standing surface waterlogged area has a dark blue to black tone depending on the depth of the water, which is in minor proportion to the blackish red mixed tone. The existence of surface waterlogging in that area is shown by the dark blue to black tone area, whereas the blackish red mixed tone area is defined as a waterlogged environment (also confirmed by water table depth maps from 2017) with supportive active growth of aquatic crops. Similarly, Mandal and Sharma (2014) discovered waterlogged patches (surface ponding) in low-lying flats and depressions as irregular shapes with dark blue to black tones during visual interpretation of IRS data (FCC).

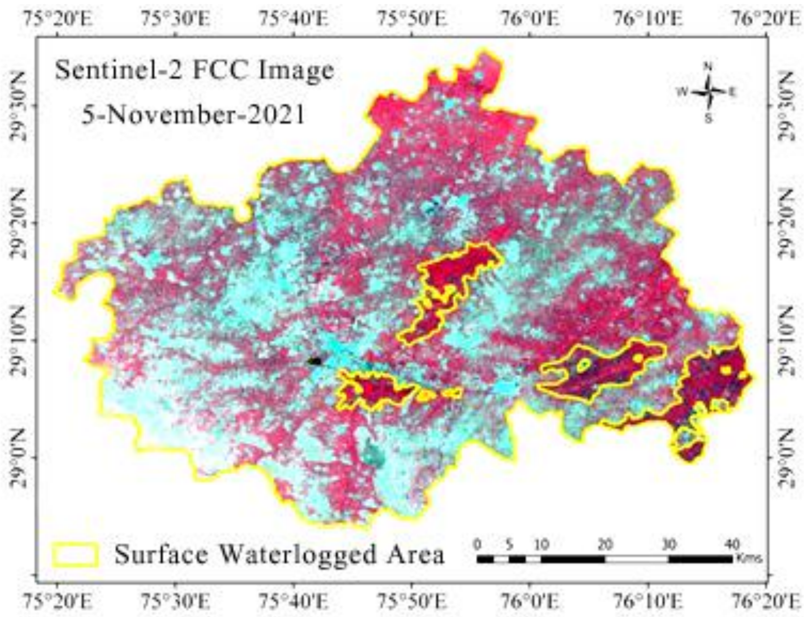

Figure: 2

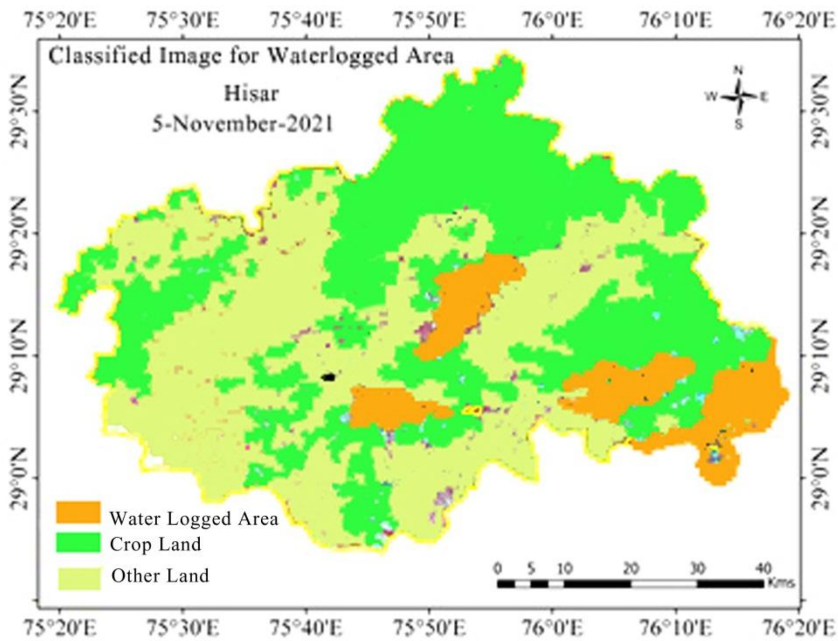

Figure:3

The surface wet areas of the site were identified using Sentinel-2 Iamge from November 5, 2021, as shown in Fig 3. The total surface waterlogged area was 22.32 percent of the total area.

The seasonal data (pre and post monsoon) of water table level revealed a greater amount of subterranean waterlogging in the Hisar district during the post monsoon (October). The region under different water table depths for pre and post monsoon is depicted in. The area under water table depth up to 3 m is deemed waterlogged and requires immediate attention. This demonstrates that in the post-monsoon season, the waterlogged region beneath shallow water table depth increases in comparison to the pre-monsoon season. Sorkhi, Sisar, Mohla, Puthi, Kumba (South-East of Hisar), Mirka, SatrodKalan, Satrod Kurd, Dhani Raipur, Kaimri (central of Hisar district), Ghirai, Garhi, DhaniMirdad, Matloda, and Rajli are among the settlements that fall within shallow water table depth (South of Hisar district).

Suggestion and Solution:

Proper surface drainage construction and management (including raised beds) is crucial in minimising off-site impacts, particularly when sediments and nutrients may reach streams and affect water quality.A variety of techniques can be taken to reduce canal seepage loss. The first step is to reduce the canals' full supply level (FSL) to a sufficient extent. The second method is to line the canal portion with seepage loss, which makes the canal section fairly watertight. The third method is to install intercepting drains that run parallel to the canal.

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